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TECHNICAL INFORMATION BULLETIN 79-3

REVISED CCITT RECOMMENDATION X.25 LEVEL 3

WORKING DRAFT

MARCH 1979

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This TIB provides the current working draft of the basic level 3 of X.25 excluding the Fast Select and Datagram provisions. It represents the work that has been completed through November 1978. Additional revisions will be forthcoming as a result of further Special Rapporteur meetings in April and Autumn 1979.

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REVISED CCITT RECOMMENDATION X.25, LEVEL 3 - WORKING DRAFT

MARCH 1979

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FOREWORD

Among the responsibilities assigned to the Office of the Manager, National Communications System, is the management of the Federal Telecommunication Standards Program which is an element of the overall GSA Federal Standardization Program. Under this program, the NCS, with the assistance of the Federal Telecommunication Standards Committee, identifies, develops, and coordinates proposed Federal Standards which either contribute to the interoperability of functionally similar Federal telecommunication systems or to the achievement of a compatible and efficient interface between computer and telecommunication systems. In developing and coordinating these standards a considerable amount of effort is expended in initiating and pursuing joint standards development efforts with appropriate technical committees of the Electronic Industries Association, the American National Standards Institute, the International Organization for Standardization, and the International Telegraph and Telephone Consultative Committee of the International Telecommunication Union. This Technical Information Bulletin presents an overview of an effort which is contributing to the development of compatible Federal, national, and international standards in the area of data communication interface standards. It has been prepared to inform interested Federal activities of the progress of these efforts. Any comments, inputs, or statements of requirements which could assist in the advancement of this work are welcome and should be addressed to:

Office of the Manager
National Communications System
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Washington, D.C. 20305
(202) 692-2124

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BACKGROUND

Intense activity over the past several years is leading to a new generation of interface standards for the emerging public data networks being implemented in numerous countries around the world. These new data networks will offer a variety of services including circuit-switched, packet-switched, and leased line to support the rapidly expanding computer and digital communications requirements.

Packet-switching technology is presently dominating current implementations as exemplified by the proposed AT&T Advanced Communications Service (ACS), Telenet, and Tymnet in the USA. Active implementation are also underway in Canada, Japan, and many European countries.

The International Telegraph and Telephone Consultative Committee (CCITT) has lead the way in early standardization of interface protocols to encourage timely implementations on a worldwide basis. In early 1976, the draft proposal was introduced into CCITT for a virtual circuit packet-switched service. Agreement was reached in May 1976, and in September 1976, the proposal was approved as Recommendation X.25 by the CCITT Sixth Plenary Assembly.

The unprecedented speed at which X.25 was adopted left serious questions as to the technical soundness of the standard. There were many uncompleted items left "for further study," and there were numerous ambiguities. The fact that international agreement was received, however, was sufficient for a number of technologically advanced countries to make large investments in implementing new public data networks using this packet-switching technology. As a result X.25 has now proved to be an effective guideline for the new generation of designs.

X.25 describes the interface and procedures for a virtual circuit type of packet-switched service and it is defined in three architectural independent levels as follows:

Level 1 - The physical, electrical, functional and procedural characteristics to establish, maintain and disconnect the physical link between the DTE and the DCE.

Level 2 - The link access procedure for data interchange across the link between the DTE and the DCE.

The Fast Select provision allows a full 128 octets of user data to be exchanged during the call set-up, and possibly clearing, procedures for a virtual call. This would greatly increase the efficiency of operation for many transaction applications.

The datagram operation has been one of considerable controversy in CCITT. Determined efforts from the USA, however, have now resulted in general acceptance. Datagrams are self-contained packets with a maximum of 128 octets of user data, and each datagram has sufficient address information to be routed to its destinations. No call set-up procedures are necessary. Datagram operation proves more effective for efficient fast transport of small units of data and provides greater flexibility for a number of network and user applications.

It should not be considered that the different modes of packet operation are competitive. They are, in fact, complementary in most effectively covering a large portion of applications. Another mode of operation to be studied in the future is a message service which will further complement the others.

When the work on the revised X.25, including the Fast Select and Datagram provision, is completed and approved by CCITT in 1980, it is expected to be adopted as a Federal Standard. Each level of X.25, earlier defined, is expected to be a separate standard. At level 1, proposed Federal Standard 1031, which adopts EIA RS-449, is expected to be applied initially. Then proposed Federal Standard 1040, which adopts the physical, functional, and mechanical characteristics of X.21 will evolve into use as industry makes equipment available. At level 2, Federal Standard 1003 will apply using the designated subset that is compatible with X.25 LAP B. Finally, at level 3, another Federal Standard will specify the network control at the packet level including the Datagram and Fast Select provisions.

The Appendix to this TIB provides the current working draft of the basic level 3 of X.25 excluding the Fast Select and Datagram provisions. It represents the work that has been completed through November 1978. Additional revisions will be forthcoming as a result of further Special Rapporteur meetings in April and Autumn 1979.

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in NCS TIB 79-4. After the April 1979 CCITT meetings of the Special Rapporteurs the Fast Select text is also expected to be available and will be issued as another NCS-TIB.

Every effort is made during the development of these standards to ensure that requirements of Federal activities are thoroughly considered in the work of CCITT Study Group VII. Accordingly, we would greatly appreciate any input your agency might care to make to the further development of X.25. Such input should be sent to the NCS office identified in the Foreword of this publication.

Copies of the currently approved X.25 including the new level 2 LAP B can be obtained from:

United States Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, Va 22161
(703) 557-4650

Order Number PB-283-257 $13.00

Additionally, the complete set of CCITT Public Data Network Series X Recommendations can be ordered:

Order Number PB-270-815 $39.00

3. DESCRIPTION OF THE PACKET LEVEL DTE/DCE INTERFACE FOR VIRTUAL CALL AND PERMANENT VIRTUAL CIRCUIT FACILITIES (LEVEL 3)

This section of the recommendation relates to the transfer of packets at the DTE/DCE interface. The procedures apply to packets which are successfully transferred across the DTE/DCE interface.

Each packet to be transferred across the DTE/DCE interface shall be contained within the link level information field which will delimit its length, and only one packet shall be contained in the information field.

NOTE: Possible insertion of more than one packet in the link level information field is for further study.

To enable simultaneous virtual calls and/or permanent virtual circuits, logical channels are used. Each virtual call or permanent virtual circuit is assigned a logical channel group number (less than or equal to 15) and a logical channel number (less than or equal to 255). For virtual calls a logical channel group number and a logical channel number are assigned during the call set-up phase. For permanent virtual circuits a logical channel group number and a logical channel number are assigned in agreement with the Administration at the time of subscription to the service. The range of logical channels used for virtual calls is agreed with the Administration at the time of subscription to the service.

3.1 Procedures for Virtual Calls

Annex 1, Figures 15/X.25, 16/X.25 and 17/X.25 show the state diagrams which give a definition of events at the packet level DTE/DCE interface for each logical channel used for virtual calls.

Annex 2 gives details of the action taken by the DCE on receipt of packets in each state shown in Annex 1. Details of the actions which should be taken by the DTE are for further study.

Packet formats are given in section 4 of this Recommendation.

3.1.1 Ready State

If there is no call in existence, a logical channel is in the READY state.

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OF

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REVISED NOVEMBER 1978

3.1.2 Call Request Packet

The calling DTE shall indicate a call request by transferring a CALL REQUEST packet across the DTE/DCE interface. The logical channel selected by the DTE is then in the DTE WAITING state (p2). The CALL REQUEST packet includes the called DTE address. The calling DTE address field may also be used. |

NOTE 1: A DTE address may be a DTE network address, an abbreviated address or any other DTE identification agreed for a period of time between the DTE and the DCE.

NOTE 2: The CALL REQUEST packet should use the logical channel in the READY state with the highest number in the range which has been agreed with the Administration. Thus the risk of call collision is minimized.

3.1.3 Incoming Call Packet

The DCE will indicate that there is an incoming call by transferring across the DTE/DCE interface an INCOMING CALL packet. This places the logical channel in the DCE WAITING state (p3) (see section 3.7). |

The INCOMING CALL packet will use the logical channel in the READY state with the lowest number. The INCOMING CALL packet includes the calling DTE address. The called DTE address field may also be used.

NOTE: A DTE address may be a DTE network address, an abbreviated address or any other DTE identification agreed for a period of time between the DTE and the DCE.

3.1.4 Call Accepted Packet

The called DTE shall indicate its acceptance of the call by transferring across the DTE/DCE interface a CALL ACCEPTED packet specifying the same logical channel as that of the INCOMING CALL packet. This places the specified logical channel in the DATA TRANSFER state (p4).

If the called DTE does not accept the call by a CALL ACCEPTED packet or does not reject it by a CLEAR REQUEST packet as described in section 3.1.7 within a specified time limit, the DCE will consider it as a procedure error from the called DTE and will clear the virtual call according to the procedure described in section 3.1.8.

The time limit is network dependent; its range is for further study.

3.1.5 Call Connected Packet

The receipt of a CALL CONNECTED packet by the calling DTE specifying the same logical channel as that specified in the CALL REQUEST packet indicates that the call has been accepted by the called DTE by means of a CALL ACCEPTED packet. This places the specified logical channel in the DATA TRANSFER state (p4).

3.1.6 Call Collision

Call collision occurs when a DTE and DCE simultaneously transfer a CALL REQUEST packet and an INCOMING CALL packet specifying the same logical channel. The DCE will proceed with the call request and cancel the incoming call.

3.1.7 Clearing by the DTE

At any time the DTE may indicate clearing by transferring across the DTE/DCE interface a CLEAR REQUEST packet. The logical channel is then in the DTE CLEAR REQUEST state (p6). When the DCE is prepared to free the logical channel, the DCE will transfer across the DTE/DCE interface a DCE CLEAR CONFIRMATION packet specifying the logical channel. The logical channel is now in the READY state (p1).

The DCE CLEAR CONFIRMATION packet can only be interpreted universally as having local significance, however within some Administration's networks clear confirmation may have end to end significance. In all cases the time spent in the DTE CLEAR REQUEST state (p6) will not exceed a network dependent limit. This limit will typically be lower than 3 minutes.

It is possible that subsequent to transferring a CLEAR REQUEST packet the DTE will receive other types of packets, dependent on the state of the logical channel, before receiving a DCE CLEAR CONFIRMATION packet.

NOTE: The calling DTE may abort a call by clearing it before it has received a CALL CONNECTED or CLEAR INDICATION packet.

The called DTE may refuse an incoming call by clearing it as described in this section rather than transmitting a CALL ACCEPTED packet as described in section 3.1.4.

3.1.8 Clearing by the DCE

The DCE will indicate clearing by transferring across the DTE/DCE interface a CLEAR INDICATION packet. The logical channel is then in the DCE CLEAR INDICATION state (p7). The DTE shall respond by transferring across the DTE/DCE interface a DTE CLEAR CONFIRMATION packet. The logical channel is now in the READY state (p1) (see section 3.7).

3.1.9 Clear Collision

Clear collision occurs when a DTE and a DCE simultaneously transfer a CLEAR REQUEST packet and a CLEAR INDICATION packet specifying the same logical channel. The DCE will consider that the clearing is completed and will not transfer a DCE CLEAR CONFIRMATION packet.

3.1.10 Unsuccessful Call

If a call cannot be established, the DCE will transfer a CLEAR INDICATION packet specifying the logical channel indicated in the CALL REQUEST packet.

3.1.11 Call Progress Signals

The DCE will be capable of transferring to the DTE clearing call progress signals as specified in Recommendation X.96.

Clearing call progress signals will be carried in CLEAR INDICATION packets which will terminate the call to which the packet refers. The method of coding CLEAR INDICATION packets containing call progress signals is detailed in section 4.

3.1.12 Data Transfer Phase

The procedures for the control of packets between DTE and DCE while in the DATA TRANSFER state are contained in section 3.3.

3.2 Procedure for Permanent Virtual Circuits

Annex 1, Figures 15/X.25 and 17/X.25 show the state diagrams which give a definition of events at the packet level DTE/DCE interface for logical channels assigned for permanent virtual circuits. Annex 2, Tables 11/X.25 and 12/X.25 give details of the action taken by the DCE on receipt of packets in each state shown in Annex 1, Figures 15/X.25 and 17/X.25. Details of the action which should be taken by the DTE are for further study.

For permanent virtual circuits there is no call set-up or clearing.

3.3 Procedures for Data and Interrupt Transfer

The data transfer procedure described in the following section applies independently to each logical channel existing at the DTE/DCE interface.

Normal network operation dictates that user data in data packets and interrupt data are all passed transparently, unaltered through the network in the case of packet DTE to packet DTE communications. Order of bits in data packets is preserved. Packet sequences are delivered as complete packet sequences. DTE Diagnostic Codes are treated as described in Sections 4.2.3, 4.4.3 and 4.5.1.

3.3.1 States for Data Transfer in Virtual Calls

Data, interrupt, flow control and reset packets may be transmitted and received by a DTE in the DATA TRANSFER state of a logical channel at the DTE/DCE interface. In this state, the flow control and reset procedures described in section 3.4 apply to data transmission on that logical channel to and from the DTE. Data, interrupt, flow control and reset packets transmitted by a DTE will be ignored by the DCE when the logical channel is in the DCE CLEAR INDICATION state.

When a call is cleared, data and interrupt packets may be discarded by the network. (See section 3.6).

Data, interrupt, flow control and reset packets that are in the network and destined for a DTE, the interface of which enters the DTE CLEAR REQUEST state (p6) may be delivered before the DCE CLEAR CONFIRMATION packet is sent to that DTE. Hence it is left to the DTE to define DTE to DTE protocols able to cope with the various possible situations that may occur.

3.3.2 Numbering of Data Packets

Each data packet transmitted at the DTE/DCE interface for each direction of transmission in a virtual call or permanent virtual circuit is sequentially numbered.

The sequence numbering scheme of the packets is performed modulo 8. The packet sequence numbers cycle through the entire range 0 to 7. As an additional facility, some Administrations will provide a sequence numbering scheme for packets being performed modulo 128. In this case, packet sequence numbers cycle through the entire range 0 to 127. The modulo, 8 or 128, is the same for both directions of transmission and is common for all logical channels at the DTE/DCE interface.

Only data packets contain this sequence number called the packet send sequence number P(S).

The first data packet to be transmitted across the DTE/DCE interface for a given direction of data transmission, after the virtual call or permanent virtual circuit has been established, has a packet send sequence number equal to 0.

A P(S) in a received data packet not containing the proper sequence number on a logical channel is considered by the DCE as a local procedure error (see Sections 3.4.2 and 4.4.3); the DCE then resets the virtual call or permanent virtual circuit.

3.3.3 Data Field Length

The standard maximum User Data Field length is 128 octets.

In addition, and in conjunction with optional user facilities, other maximum data field lengths may be offered by Administrations.

If an optional maximum data field length is selected at subscription it becomes the default maximum data field length common to all logical channels at the DTE/DCE interface. The Administration may also permit selection of a maximum data field length on a per call basis (see Section 5.1.2).

Optional maximum data field lengths offered will be chosen by each Administration from the following list: 16, 32, 64, 256, 512 and 1024 octets.

The data field of data packets transmitted by a DTE or DCE may contain any number of bits up to the agreed maximum.

If a DTE or DCE wishes to indicate a sequence of more than one packet, it uses a MORE DATA mark as defined below:

In a full data packet a DTE or DCE may indicate that more data is to follow with a mark called MORE DATA. This indication has the effect that such a packet may be combined with the subsequent data packet within the network.

Two categories of data packets are defined:

Category 1	a)	Packets which do not have the local maximum data field length.
	b)	Packets having the local maximum data field legnth and no MORE DATA mark.
Category 2		Packets having the local maximum data

field length and a MORE DATA mark.

Category 1 packets will not be combined with subsequent packets.

A complete packet sequence is defined as being composed of either a single category 1 packet or consecutive category 2 packets and a category 1 packet. The sequence shall not be preceded by a category 2 packet.

When transmitted by a source DTE, a complete packet sequence is always delivered to the destination DTE as a complete packet sequence.

Thus, if the receiving end has a larger maximum data field length than the transmitting end, then packets within a complete packet sequence will be combined within the network. They will be delivered in a complete packet sequence where each packet has the exact maximum data field length and the MORE DATA mark set to 1, except for the last one, the User Data Field of which may have less than the maximum length.

If the maximum data field length is the same at both ends, then data fields of data packets are delivered to the receiving DTE exactly as they have been received by the network, except possibly with one exception: if a full packet with a MORE DATA mark set to 1 is followed by an empty packet. Then the two last packets can be merged so as to become a single full packet with the MORE DATA mark set to 0.

If the receiving end has a smaller maximum data field length than the transmitting end, then packets will be segmented within the network, and the MORE DATA mark set by the network as described to maintain complete packet sequences.

All category 1 DATA packets received by a DTE will have the MORE data mark set to 0.

If the User Data Field in a data packet exceeds the locally permitted maximum field length then the DCE will reset the virtual call or permanent virtual circuit with the resetting cause "local procedure error".

3.3.4 Qualifier bit

A packet sequence may be on one of two levels. If a DTE wishes to transmit data on more than one level, it uses an indicator called the QUALIFIER bit.

When only one level of data is being transmitted on a logical channel, the QUALIFIER bit is always set to zero. If two levels of data are being transmitted, the transmitting DTE should set

the QUALIFIER bit in all packets of a complete packet sequence to the same value, either zero or one. A complete packet sequence, which is transmitted with the QUALIFIER bit set to the same value in all packets, is delivered by the network as a complete packet sequence with the QUALIFIER bit set in all packets to the value assigned by the transmitting DTE.

The action of the network when the QUALIFIER bit is not set to the same value by the transmitting DTE within a complete packet sequence is left for further study.

Packets are numbered consecutively regardless of their data level.

Provisional Recommendation X.29 gives an example of the procedures to be used when the QUALIFIER bit is set to one.

3.3.5 Interrupt Procedure

The interrupt procedure allows a DTE to transmit data to the remote DTE, without following the flow control procedure applying to data packets (see section 3.4). The interrupt procedure can only apply in the FLOW CONTROL READY state (d1) within the DATA TRANSFER state (p4).

The interrupt procedure has no effect on the transfer and flow control procedures applying to the data packets on the virtual call or permanent virtual circuit.

To transmit an interrupt, a DTE transfers across the DTE/DCE interface a DTE INTERRUPT packet. The DCE will then confirm the receipt of the interrupt by transferring a DCE INTERRUPT CONFIRMATION packet. The DTE should not transmit further DTE INTERRUPT packets until the first one is confirmed with a DCE INTERRUPT CONFIRMATION packet.

The DCE indicates an interrupt from the remote DTE by transferring across the DTE/DCE interface a DCE INTERRUPT packet containing the same data field as in the DTE INTERRUPT packet transmitted by the remote DTE. The DTE will confirm the receipt of the DCE INTERRUPT packet by transferring a DTE INTERRUPT CONFIRMATION packet.

The receipt of a DCE INTERRUPT CONFIRMATION packet indicates that the interrupt has been confirmed by the remote DTE by means of a DTE INTERRUPT CONFIRMATION packet.

An INTERRUPT packet is delivered at or before the point in the stream of DATA packets at which it was generated.

3.4 Procedures for Flow Control

This subsection only applies to the data transfer phase and specifies the procedures covering flow control of data packets and reset on each logical channel used for a virtual call or a permanent virtual circuit.

For each direction of data transmission on a virtual call or permanent virtual circuit, a throughput class can be identified which directly corresponds to the rate at which packets can be transmitted. The throughput class indicates the throughput that does not need to be exceeded for that direction of traffic. Details on throughput classes are given in 3.4.1.3.

3.4.1 Procedure for Flow Control

At the DTE/DCE interface of a logical channel used for a virtual call or permanent virtual circuit, the transmission of data packets is controlled separately for each direction and is based on authorizations from the receiver.

3.4.1.1 Window Description

At the DTE/DCE interface of a logical channel used for a virtual call or permanent virtual circuit and for each direction of data transmission, a window is defined as the ordered set of W consecutive packet send sequence numbers of the data packets authorized to cross the interface.

The lowest sequence number in the window is referred to as the lower window edge. When a virtual call or permanent virtual circuit at the DTE/DCE interface has just been established, the window related to each direction of data transmission has a lower window edge equal to 0.

The packet send sequence number of the first data packet not authorized to cross the interface is the value of the lower window edge plus W (modulo 8, or 128 when extended).

In the absence of an optional user facility, the window size W for each direction of data transmission at a DTE/DCE interface is common to all the logical channels and agreed for a period of time between the DTE and the Administration. The value of W does not exceed 7, or 127 when extended (see section 5.1.2).

3.4.1.2 Flow Control Principles

A number modulo 8, or 128 when extended, referred to as a packet receive sequence number P(R), conveys across the DTE/DCE interface information from the receiver for the transmission of data packets. When transmitted across the DTE/DCE interface,

a P(R) becomes the lower window edge. In this way, additional data packets may be authorized by the receiver to cross the DTE/DCE interface.

When the sequence number P(S) of the next data packet to be transmitted by the DTE is within the window, the DCE will accept this data packet. When the sequence number P(S) of the next data packet to be transmitted by the DTE is outside of the window, the DCE will consider the receipt of this data packet from the DTE as a procedure error and will reset the virtual call or permanent virtual circuit. The DTE should follow the same procedure.

When the sequence number P(S) of the next packet to be transmitted by the DCE is within the window, the DCE is authorized to transmit this data packet to the DTE. When the sequence number P(S) of the next data packet to be transmitted by the DCE is outside of the window, the DCE shall not transmit a data packet to the DTE.

The packet receive sequence number, P(R), is conveyed in data, RECEIVE READY (RR) and RECEIVE NOT READY (RNR) packets.

The value of a P(R) received by the DCE must be within the range from the last P(R) received by the DCE up to and including the packet send sequence number of the next data packet to be transmitted by the DCE. Otherwise, the DCE will consider the receipt of this P(R) as a procedure error and will reset the virtual call or permanent virtual circuit. The DTE should follow the same procedure.

The receive sequence number P(R) is less than or equal to the sequence number of the next expected data packet and implies that the DTE or DCE transmitting P(R) has accepted <u>at least</u> all data packets numbered up to and including P(R)-1.

The only universal significance of a P(R) value is a local updating of the window across the packet level interface. The P(R) value may be used within some Administration's networks to convey an end-to-end acknowledgement.

3.4.1.3 <u>Throughput Class</u>

A throughput class for one direction of transmission is an indication of the throughput that does not need to be exceeded on virtual calls or permanent virtual circuits. Thus, the network is asked to allocate such resources that the throughput class can normally be reached. However, due to the statistical sharing of transmission and switching resources, it is not guaranteed that the the throughput class can be reached 100% of the time.

Depending on the network and the applicable conditions at the considered moment, the effective throughput may exceed the throughput class.

The throughput class may only be reached if the following conditions are met:

(a) the access data links of both ends of a virtual call or permanent virtual circuit are engineered for the throughput class;

(b) the receiving DTE is not flow controlling the DCE such that the throughput class is not reachable; and

(c) the transmitting DTE is sending data packets which have the maximum data field length.

The throughput class is expressed in octets/second; at a DTE/DCE interface, a maximum data field length is specified for a virtual call or permanent virtual circuit, and thus the throughput class can be interpreted by the DTE as the number of full data packets/second that the DTE does not have a need to exceed.

NOTE: The definition of throughput class in terms of quality of service is for further study.

3.4.1.4 DTE and DCE Receive Ready (RR) Packets

RR packets are used by the DTE or DCE to indicate that it is ready to receive the W data packets within the window starting with P(R), where P(R) is indicated in the RR packet.

3.4.1.5 DTE and DCE Receive Not Ready (RNR) Packets

RNR packets are used by the DTE or DCE to indicate a temporary inability to accept additional data packets for a given virtual call or permanent virtual circuit. A DTE or DCE receiving an RNR packet shall stop transmitting data packets on the indicated logical channel, but the window is updated by the P(R) value of the RNR packet. The receive not ready situation indicated by the transmission of RNR packet is cleared by the transmission in the same direction of an RR packet or by a reset procedure being initiated.

The transmission of an RR after an RNR at the packet level is not to be taken as a demand for retransmission of packets which have already been transmitted but still are in the window indicated in the RR.

3.4.2 Procedure for Reset

The reset procedure is used to re-initialize the virtual call or permanent virtual circuit and in so doing removes in each direction all data and interrupt packets which may be in the network. (See section 3.6). The reset procedure can only apply in the DATA TRANSFER state of the DTE/DCE interface. In any other state of the DTE/DCE interface, the reset procedure is abandoned. For example, when a clearing or restarting procedure is initiated, RESET REQUEST and RESET INDICATION packets can be left unconfirmed.

For flow control, there are three states d1, d2 and d3 within the DATA TRANSFER state (p4). They are FLOW CONTROL READY (d1), DTE RESET REQUEST (d2), and DCE RESET INDICATION (d3) as shown in the state diagram in Annex 1, Figure 17/X.25. When entering state p4 the logical channel is placed in state d1. Annex 2, Table 11/X.25 specifies actions taken by the DCE on the receipt of packets from the DTE.

When a virtual call or permanent virtual circuit at the DTE/DCE interface has just been reset, the window related to each direction of data transmission has a lower window edge equal to 0, and the numbering of subsequent data packets to cross the DTE/DCE interface for that direction of data transmission shall start from 0.

3.4.2.1 Reset Request Packet

The DTE shall indicate a request for reset by transmitting a RESET REQUEST packet specifying the logical channel. This places the logical channel in the DTE RESET REQUEST state (d2).

3.4.2.2 Reset Indication Packet

The DCE shall indicate a reset by transmitting to the DTE a RESET INDICATION packet specifying the logical channel and the reason for the resetting. This places the logical channel in the DCE RESET INDICATION state (d3). In this state, the DCE will ignore data, interrupt, RR and RNR packets. (See section 3.7).

3.4.2.3 Reset Collision

Reset collision can occur when a DTE and a DCE simultaneously transmit a RESET REQUEST packet and a RESET INDICATION packet. In such a case, the second one of both those packets crossing the interface is considered as a reset confirmation. This places the logical channel in the FLOW CONTROL READY state (d1).

3.4.2.4 Reset Confirmation Packets

When the logical channel is in the DTE RESET REQUEST state, the DCE will confirm reset by transmitting to the DTE a DCE RESET CONFIRMATION packet. This places the logical channel in the FLOW CONTROL READY state (d1).

The DCE RESET CONFIRMATION packet can only be interpreted universally as having local significance, however within some Administration's networks reset confirmation may have end to end significance. In all cases the time spent in the DTE RESET REQUEST state (d2) will not exceed a network dependent limit. The limit will typically be lower than 3 minutes.

When the logical channel is in the DCE RESET INDICATION state, the DTE will confirm reset by transmitting to the DCE a DTE RESET CONFIRMATION packet. This places the logical channel in the FLOW CONTROL READY state (d1). (See section 3.7).

3.5 Procedure for Restart

The restart procedure is used to simultaneously clear all the virtual calls and reset all the permanent virtual circuits at the DTE/DCE interface. (See section 3.6).

Annex 1, Figure 15/X.25 gives the state diagram which defines the logical relationships of events related to the restart procedure.

Annex 2, Table 12/X.25 specifies actions taken by the DCE on the receipt of packets from the DTE. Details of the action which should be taken by the DTE are for further study.

3.5.1 Restart by the DTE

The DTE may at any time request a restart by transferring across the DTE/DCE interface a RESTART REQUEST packet. The interface for each logical channel is then in the DTE RESTART REQUEST state.

The DCE will confirm the restart by transferring a DCE RESTART CONFIRMATION packet placing the logical channels used for virtual calls in the READY state (p1), and the logical channels used for permanent virtual circuits in the FLOW CONTROL READY state (d1).

The DCE RESTART CONFIRMATION packet can only be interpreted universally as having local significance. The time spent in the DTE RESTART REQUEST state (r2) will not exceed a network dependent limit.

3.5.2 Restart by the DCE

The DCE may indicate a restart by transferring across the DTE/DCE interface a RESTART INDICATION packet. The interface for each logical channel is then in the DCE RESTART INDICATION state (r3). In this state of the DTE/DCE interface, the DCE will ignore data, interrupt, call set-up and clearing, flow control and reset packets.

The DTE will confirm the restart by transferring a DTE RESTART CONFIRMATION packet placing the logical channels used for virtual calls in the READY state (p1), and the logical channels used for permanent virtual circuits in the FLOW CONTROL READY state (d1). (See section 3.7).

3.5.3 Restart Collision

Restart collision can occur when a DTE and a DCE simultaneously transfer a RESTART REQUEST and a RESTART INDICATION packet. Under this circumstance, the DCE will consider that the restart is completed and will not expect a DTE RESTART CONFIRMATION packet, neither will it transfer a DCE RESTART CONFIRMATION packet.

3.6 Effect of Clear, Reset and Restart Procedures on the Transfer of Packets

All data and interrupt packets generated by a DTE (or the network) before initiation by the DTE or the DCE of a clear, reset or restart procedure at the local interface will either be delivered to the remote DTE before the DCE transmits the corresponding indication on the remote interface, or discarded by the network.

No data or interrupt packets generated by a DTE (or the network) after the completion of a reset (or for permanent virtual circuits also a restart) procedure at the local interface will be delivered to the remote DTE before the completion of the corresponding reset procedure at the remote interface.

When a DTE initiates a clear, reset or restart procedure on its local interface, all data and interrupt packets which were generated by the remote DTE (or the network) before the corresponding indication is transmitted to the remote DTE will be either delivered to the initiating DTE before DCE confirmation of the initial clear, reset or restart request, or discarded by the network.

NOTE: The maximum number of packets which may be discarded is a function of network end-to-end delay and throughout class, and, in general, has no relation to the local window size. Provision of more precise information is for further study. Within networks which convey end-to-end significance of P(R), the maximum number of packets which may be discarded in one transmission direction is not larger than the window size at the DTE/DCE interface of the transmitting DTE.

3.7 List of System Parameters

The system parameters applying to section 3 are for further study. This study should include considerations of timeouts, maximum numbers of retries and action to be taken when these maximum numbers are reached.

3.8 Effects of Levels 1 and 2 on Level 3

Changes of operational states of level 1 and 2 of the DTE/DCE interface do not implicitly change the state of each logical channel at level 3. Such changes when they occur are explicitly indicated at level 3 by the use of restart, clear or reset procedures as appropriate.

A failure on levels 1 and/or 2 is defined as a condition in which the DCE cannot transmit and receive any frames because of abnormal conditions caused by for instance line fault between DTE and DCE.

When a failure on levels 1 and/or 2 is detected, the DCE will transmit to the remote end

(a) a reset indicating Out of Order for a permanent virtual circuit and

(b) a clear indicating Out of Order for an existing virtual call.

During the failure, the DCE will clear any incoming virtual calls.

When the failure is recovered on levels 1 and 2, the DCE will send a RESTART INDICATION packet indicating Network Operational to the local DTE and this will result in a reset indicating Remote DTE Operational to be transmitted to the remote end of each permanent virtual circuit.

In other out of order conditions on level 1 and/or 2, including transmission of a DISC command by the DTE, the behavior of the DCE is for further study.

4. PACKET FORMATS FOR VIRTUAL CALL AND PERMANENT VIRTUAL CIRCUIT FACILITIES

4.1 General

The possible extension of packet formats by the addition of new fields is for further study.

NOTE: Any such field:

(a) would only be provided as an addition following all previously defined fields, and not as an insertion between any of the previously defined fields.

(b) would be transmitted to a DTE only when either the DCE has been informed that the DTE is able to interpret this field and act upon it, or when the DTE can ignore the field without adversely affecting the operation of the DCE.

(c) would not contain any information pertaining to a user facility to which the DTE has not subscribed.

Bits of an octet are numbered 8 to 1 where bit 1 is the low order bit and is transmitted first. Octets of a packet are consecutively numbered starting from 1 and are transmitted in this order.

4.1.1 General Format Identifier

The General Format Identifier field is a four bit binary coded field which is provided to indicate the general format of the rest of the header. The General Format Identifier field is located in bit positions 8, 7, 6 and 5, of octet 1, and bit 5 is the low order bit (see Table 5/X.25).

Two of the sixteen possible codes are used to identify the formats for the DTE/DCE interface defined herein, which provide for virtual call and permanent virtual circuit facilities. Two other codes are used to identify the similar formats in the case sequence numbering scheme of data packets is performed modulo 128. Other codes of the General Format Identifier are unassigned.

NOTE: It is envisaged that unassigned codes could identify alternative packet formats associated with other facilities or simplified access procedures, for example, datagram facility or single access DTE procedures.

TABLE 5/X.25

GENERAL FORMAT IDENTIFIER

GENERAL FORMAT IDENTIFIER		Octet 1 bits 8 7 6 5
Data packets	Sequence numbering scheme modulo 8	X 0 0 1
	Sequence numbering scheme modulo 128	X 0 1 0
Call set-up and clearing, flow control, interrupt, reset and restart packets	Sequence numbering scheme modulo 8	0 0 0 1
	Sequence numbering scheme modulo 128	0 0 1 0

NOTE: A bit which is indicated as "X" may be set to either "0" or "1" as discussed in subsequent sections.

4.1.2 Logical Channel Group Number

The logical channel group number appears in every packet except in restart packets (see section 4.5) in bit positions 4, 3, 2 and 1 of octet 1.

This field is binary coded and bit 1 is the low order bit of the Logical Channel Group Number.

4.1.3 Logical Channel Number

The logical channel number appears in every packet except in restart packets (see section 4.5) in all bit positions of octet 2. This field is binary coded and bit 1 is the low order bit of the Logical Channel Number.

NOTE: Logical channels are numbered from 0 to 4095 using 12 bits made up of the 4 bits of the Logical Channel Group Number and the 8 bits of the Logical Channel Number. The numbering is binary coded using bit positions 4 through 1 of octet 1 followed by bit positions 8 through 1 of octet 2 with bit 1 of octet 2 as the low order bit.

4.1.4 Packet Type Identifier

Each packet shall be identified in the octet 3 of the packet according to the following Table 6/X.25.

TABLE 6/X.25

PACKET TYPE IDENTIFIER

PACKET TYPE		OCTET 3 BITS 8 7 6 5 4 3 2 1
FROM DCE TO DTE	FROM DTE TO DCE	
CALL SET-UP AND CLEARING		
INCOMING CALL	CALL REQUEST	0 0 0 0 1 0 1 1
CALL CONNECTED	CALL ACCEPTED	0 0 0 0 1 1 1 1
CLEAR INDICATION	CLEAR REQUEST	0 0 0 1 0 0 1 1
DCE CLEAR CONFIRMATION	DTE CLEAR CONFIRMATION	0 0 0 1 0 1 1 1
DATA AND INTERRUPT		
DCE DATA	DTE DATA	X X X X X X X 0
DCE INTERRUPT	DTE INTERRUPT	0 0 1 0 0 0 1 1
DCE INTERRUPT CONFIRMATION	DTE INTERRUPT CONFIRMATION	0 0 1 0 0 1 1 1
FLOW CONTROL AND RESET		
DCE RR	DTE RR	X X X 0 0 0 0 1
DCE RNR	DTE RNR	X X X 0 0 1 0 1
	DTE REJ*	X X X 0 1 0 0 1
RESET INDICATION	RESET REQUEST	0 0 0 1 1 0 1 1
DCE RESET CONFIRMATION	DTE RESET CONFIRMATION	0 0 0 1 1 1 1 1
DCE RR (MODULO 128)*	DTE RR (MODULO 128)*	0 0 0 0 0 0 0 1
DCE RNR (MODULO 128)*	DTE RNR (MODULO 128)*	0 0 0 0 0 1 0 1
	DTE REJ (MODULO 128)*	0 0 0 0 1 0 0 1
RESTART		
RESTART INDICATION	RESTART REQUEST	1 1 1 1 1 0 1 1
DCE RESTART CONFIRMATION	DTE RESTART CONFIRMATION	1 1 1 1 1 1 1 1

* Not necessarily available on every network. Use of the DTE REJ packet is described in section 5.1.5.

<u>NOTE</u>: A bit which is indicated as "X" may be set to either "0" or "1" as discussed in subsequent sections.

4.2 Call Set-Up and Clearing Packets

4.2.1 Call Request and Incoming Call Packets

Figure 1/X.25 illustrates the format of CALL REQUEST and INCOMING CALL packets.

Address Lengths Field

Octet 4 consists of field length indicators for the called and calling DTE addresses. Bits 4, 3, 2 and 1 indicate the length of the called DTE address in semi-octets. Bits 8, 7, 6 and 5 indicate the length of the calling DTE address in semi-octets. Each address length indicator is binary coded and bit 1 or 5 is the low order bit of the indicator.

Address Field

Octet 5 and the following octets consist of the called DTE address when present, then the calling DTE address when present.

Each digit of an address is coded in a semi-octet in binary coded decimal with bit 5 or 1 being the low-order bit of the digit.

Starting from the high order digit, the address is coded in octet 5 and consecutive octets with two digits per octet. In each octet, the higher order digit is coded in bits 8, 7, 6 and 5.

The Address Field shall be rounded up to an integral number of octets by inserting zeros in bits 4, 3, 2 and 1 of the last octet of the field when necessary.

NOTE: This field may be used for optional addressing facilities such as abbreviated addressing. The opticnal addressing facilities employed as well as the coding of those facilities is for further study.

Facility Length Field

Bits 6, 5, 4, 3, 2 and 1 of the octet following the Address Field indicate the length of the Facility Field in octets. The facility length indicator is binary coded and bit 1 is the low order bit of the indicator.

Bits 8 and 7 of this octet are unassigned and set to 0.

Facility Field

The Facility Field is present only when the DTE is using an optional user facility requiring some indication in the CALL REQUEST and INCOMING CALL packets.

The coding of this facility field is defined in section 5.

The Facility Field contains an integral number of octets. The actual maximum length of this field depends on the facilities which are offered by the network. However, this maximum does not exceed 62 octets.

Call User Data Field

Following the Facility Field, the Call User Data Field may be present and has a maximum length of 16 octets.

The Call User Data Field, when present, is comprised of two fields.

1. The Protocol Identifier Field

2. The Call Data Field.

The Protocol Identifier Field is used for protocol identification purposes, and the Call Data Field contains user data. One example of usage and coding of the Protocol Identifier Field is specified in Provisional Recommendation X.29.

The Protocol Identifier Field is up to four octets in length and the Call Data Field, when present, starts at the beginning of the fifth octet of the Call User Data Field.

Bits 8 and 7 of the first octet of the Protocol Identifier Field determine the use of the rest of the Protocol Identifier Field.

Users are cautioned that if these 2 bits have any value other than 11, the protocol thus identified may also be implemented within public data networks.

On the other hand, if these two bits have the value 11, the protocol thus identified is one which public data networks do not implement.

NOTE: When a virtual call is being established between two packet mode DTE's, the network does not act on any part of the Call User Data Field, unless required to do otherwise by an appropriate request for an optional user facility on a per call basis. Such a facility is for further study.

4.2.2 Call Accepted and Call Connected Packets

Figure 2/X.25 illustrates the format of CALL ACCEPTED and CALL CONNECTED packets.

Address Lengths Field

Octet 4 consists of field length indicators for the called and calling DTE addresses. Bits 4, 3, 2 and 1 indicate the length of the called DTE address in semi-octets. Bits 8, 7, 6 and 5 indicate the length of the calling DTE address in semi-octets. Each address length indicator is binary coded and bit 1 or 5 is the low order bit of the indicator.

Address Field

Octet 5 and the following octets consist of the called DTE address when present, then the calling DTE address when present.

Each digit of an address is coded in a semi-octet in binary coded decimal with bit 5 or 1 being the low-order bit of the digit.

Starting from the high order digit, the address is coded in octet 5 and consecutive octets with two digits per octet. In each octet, the higher order digit is coded in bits 8, 7, 6 and 5.

The address field shall be rounded up to an integral number of octets by inserting zeros in bits 4, 3, 2 and 1 of the last octet of the field when necessary.

Note: This field may be used for optional addressing facilities such as abbreviated addressing. The optional addressing facilities employed as well as the coding of those facilities is for further study.

Facility Length Field

Bits 6, 5, 4, 3, 2 and 1 of the octet following the Address Field indicate the length of the Facility Field in octets. The facility length indicator is binary coded and bit 1 is the low order bit of the indicator.

Bits 8 and 7 of this octet are unassigned and set to 0.

Facility Field

The facility field is present only when the DTE is using an optional user facility requiring some indication in the CALL ACCEPTED and CALL CONNECTED packets.

The coding of this facility field is defined in section 5.

The Facility Field contains an integral number of octets. The actual maximum length of this field depends on the facilities which are offered by the network. However, this maximum does not exceed 62 octets.

4.2.3 Clear Request and Clear Indication Packets

Figure 3/X.25 illustrates the format of CLEAR REQUEST and CLEAR INDICATION packets.

Clearing Cause Field

Octet 4 is the Clearing Cause Field and contains the reason for the clearing of the call.

The coding of the Clearing Cause Field in CLEAR INDICATION packets is given in Table 7/X.25.

The bits of the Clearing Cause Field in CLEAR REQUEST packets should be set to 0 by the DTE. It is for further study whether other values of these bits are ignored or processed by the DCE.

Diagnostic Code

Octet 5 is the Diagnostic Code and contains additional information on the reason for the clearing of the call.

In a CLEAR REQUEST packet, the Diagnostic Code is not mandatory.

In a CLEAR INDICATION packet, if the Clearing Cause Field indicates DTE Clearing, the Diagnostic Code is passed unchanged from the clearing DTE. If the clearing DTE has not provided a Diagnostic Code in its CLEAR REQUEST packet, then the bits of the Diagnostic Code in the resulting CLEAR INDICATION packet will all be zero.

When a CLEAR INDICATION packet results from a RESTART REQUEST packet, the value of the Diagnostic Code will be that specified in the RESTART REQUEST packet, or all zeros in the case where no Diagnostic Code has been specified in RESTART REQUEST.

When the Clearing Cause Field does not indicate DTE Clearing, the bits of the Diagnostic Code in a CLEAR INDICATION packet are all set to 0 when no specific additional information for the clearing is supplied. Other values are for further study.

NOTE: The contents of the diagnostic code field does not alter the meaning of the cause field. A DTE is not required

to undertake any action on the contents of the diagnostic code field. Unspecified code combinations in the diagnostic code field shall not cause the DTE to not accept the cause field.

TABLE 7/X.25

CODING OF CLEARING CAUSE FIELD IN CLEAR INDICATION PACKET

	8 7 6 5 4 3 2 1
DTE Clearing	0 0 0 0 0 0 0 0
Number Busy	0 0 0 0 0 0 0 1
Out of Order	0 0 0 0 1 0 0 1
Remote Procedure Error	0 0 0 1 0 0 0 1
Reverse Charging Not Subscribed	0 0 0 1 1 0 0 1
Invalid Call	0 0 0 0 0 0 1 1
Access Barred	0 0 0 0 1 0 1 1
Local Procedure Error	0 0 0 1 0 0 1 1
Network Congestion	0 0 0 0 0 1 0 1
Not Obtainable	0 0 0 0 1 1 0 1
DTE Incompatible Call	0 0 1 0 0 0 0 1

4.2.4 <u>DTE and DCE Clear Confirmation Packets</u>

Figure 4/X.25 illustrates the format of the DTE and DCE CLEAR.

4.3 <u>Data and Interrupt Packets</u>

4.3.1 <u>DTE and DCE Data Packets</u>

Figure 5/X.25 illustrates the format of the DTE and DCE DATA packets.

<u>Qualifier Bit</u>

Bit 8 in octet 1 is the QUALIFIER bit.

<u>Packet Receive Sequence Number</u>

Bits 8, 7 and 6 of octet 3 or bits 8 through 2 of octet 4, when extended, are used for indicating the Packet Receive Sequence Number P(R). P(R) is binary coded and bit 6, or bit 2 when extended, is the low order bit.

More Data Indication

Bit 5 in octet 3, or bit 1 in octet 4 when extended, is used for MORE DATA indication: 0 for no more data and 1 for more data.

Packet Send Sequence Number

Bits 4, 3 and 2 of octet 3, or bits 8 through 2 of octet 3 when extended, are used for indicating the Packet Send Sequence Number P(S). P(S) is binary coded and bit 2 is the low order bit.

User Data Field

Bits following octet 3, or octet 4 when extended, contain user data.

4.3.2 DTE and DCE Interrupt Packets

Figure 6/X.25 illustrates the format of the DTE and DCE INTERRUPT packets.

Interrupt User Data Field

Octet 4 contains user data.

4.3.3 DTE and DCE Interrupt Confirmation Packets

Figure 7/X.25 illustrates the format of the DTE and DCE INTERRUPT CONFIRMATION packets.

4.4 Flow Control and Reset Packets

4.4.1 DTE and DCE Receive Ready (RR) Packets

Figure 8/X.25 illustrates the format of the DTE and DCE RR packets.

Packet Receive Sequence Number

Bits 8, 7 and 6 of octet 3, or bits 8 through 2 of octet 4 when extended, are used for indicating the Packet Receive Sequence Number P(R). P(R) is binary coded and bit 6, or bit 2 when extended, is the low order bit.

4.4.2 DTE and DCE Receive Not Ready (RNR) Packets

Figure 9/X.25 illustrates the format of the DTE and DCE RNR packets.

Packet Receive Sequence Number

Bits 8, 7 and 6 of octet 3, or bits 8 through 2 of octet 4 when extended, are used for indicating the Packet Receive Sequence Number P(R). P(R) is binary coded and bit 6, or bit 2 when extended, is the low order bit.

4.4.3 Reset Request and Reset Indication Packets

Figure 10/X.25 illustrates the format of the RESET REQUEST and RESET INDICATION packets.

Resetting Cause Field

Octet 4 is the Resetting Cause Field and contains the reason for the reset.

The coding of the Resetting Cause Field in a RESET INDICATION packet is given in Table 8/X.25.

The bits of the Resetting Cause Field in a RESET REQUEST packet should be set to 0 by the DTE. It is for further study whether other values of these bits are ignored or processed by the DCE.

Diagnostic Code

Octet 5 is the Diagnostic Code and contains additional information on the reason for the reset.

In a RESET REQUEST packet the Diagnostic code is not mandatory.

In a RESET INDICATION packet, if the Resetting Cause Field indicates a DTE Reset, the Diagnostic Code has been passed unchanged from the resetting DTE. If the DTE requesting a reset has not provided a Diagnostic Code in its RESET REQUEST packet, then the bits of the Diagnostic Code in the resulting RESET INDICATION packet will all be zeros.

If a RESET INDICATION packet results from a RESTART REQUEST packet, the value of the Diagnostic Code will be that specified in the RESTART REQUEST, or all zeros in the case where no Diagnostic Code has been specified in RESTART REQUEST.

If the Resetting Cause Field does not indicate a DTE Reset, the bits of the Diagnostic Code in a RESET INDICATION packet are all set to 0 when no specific additional information for the reset is supplied. Other values are for further study.

NOTE: The contents of the diagnostic code field does not alter the meaning of the cause field. A DTE is not required to undertake any action on the contents of the diagnostic code field. Unspecified code combinations in the diagnostic code field shall not cause the DTE to not accept the cause field.

TABLE 8/X.25

CODING OF RESETTING CAUSE FIELD IN RESET INDICATION PACKET

	8 7 6 5 4 3 2 1
DTE Reset	0 0 0 0 0 0 0 0
Out of Order*	0 0 0 0 0 0 0 1
Remote Procedure Error	0 0 0 0 0 0 1 1
Local Procedure Error	0 0 0 0 0 1 0 1
Network Congestion	0 0 0 0 0 1 1 1
Remote DTE Operational*	0 0 0 0 1 0 0 1
Network Operational	0 0 0 0 1 1 1 1

* Applicable to permanent virtual circuits only.

4.4.4 DTE and DCE Reset Confirmation Packets

Figure 11/X.25 illustrates the format of the DTE and DCE RESET CONFIRMATION packets.

4.5 Restart Packets

4.5.1 Restart Request and Restart Indication Packets

Figure 12/X.25 illustrates the format of the RESTART REQUEST and RESTART INDICATION packets. Bits 4, 3, 2 and 1 of the first octet and all bits of the second octet are set to 0.

Restarting Cause Field

Octet 4 is the Restarting Cause Field and contains the reason for the restart.

The coding of the Restarting Cause Field in the RESTART INDICATION packets is given in Table 9/X.25.

The bits of the Restarting Cause Field in RESTART REQUEST packets should be set to 0 by the DTE. It is for further study whether other values of these bits are ignored or processed by the DCE.

Diagnostic Code

Octet 5 is the Diagnostic Code and contains additional information on the reason for the restart. In a RESTART REQUEST packet, the Diagnostic Code is not mandatory.

The Diagnostic Code, if specified, is passed to the corresponding DTEs as the Diagnostic Code of either a RESET INDICATION packet or a CLEAR INDICATION packet as appropriate. The bits of the Diagnostic Code in a RESTART INDICATION packet are all set to zero when no specific additional information for the restart is supplied. Other values are for further study.

NOTE: The contents of the diagnostic code field does not alter the meaning of the cause field. A DTE is not required to undertake any action on the contents of the diagnostic code field. Unspecified code combinations in the diagnostic code field shall not cause the DTE to not accept the cause field.

TABLE 9/X.25

CODING OF RESTARTING CAUSE FIELD IN RESTART INDICATION PACKETS

	8 7 6 5 4 3 2 1
Local Procedure Error	0 0 0 0 0 0 0 1
Network Congestion	0 0 0 0 0 0 1 1
Network Operational	0 0 0 0 0 1 1 1

4.5.2 DTE and DCE Restart Confirmation Packets

Figure 13/X.25 illustrates the format of the DTE and DCE RESTART CONFIRMATION packets. Bits 4, 3, 2 and 1 of the first octet and all bits of the second octet are set to 0.

4.6 Packets Required for Optional User Facilities

4.6.1 DTE Reject (REJ) Packets

Figure 14/X.25 illustrates the format of the DTE REJ packets, used in conjunction with the Packet Retransmission Facility described in section 5.

Packet Receive Sequence Number

Bits 8, 7 and 6 of Octet 3, or bits 8 through 2 of octet 4 when extended, are used for indicating the Packet Receive Sequence Number P(R). P(R) is binary coded and bit 6, or bit 2 when extended, is the low order bit.

5. PROCEDURES AND FORMATS FOR OPTIONAL USER FACILITIES TO BE STUDIED FOR VIRTUAL CALL AND PERMANENT VIRTUAL CIRCUIT FACILITIES

The following is a technical description of procedures and formats for user facilities which have been proposed for study for inclusion in Recommendation X.2, this being for further study.

NOTE: However, the closed user group facility is already mentioned in Recommendation X.2.

5.1 Procedures for Optional User Facilities

5.1.1 Reverse Charging

Reverse Charging is an optional user facility; it can be requested by a DTE for a given virtual call.

The reverse charging facility needs some indication in the CALL REQUEST and the INCOMING CALL packets.

5.1.2 Throughput Class Selection and Indication

Throughput class selection and indication is an optional user facility agreed for a period of time which can be used by a DTE for virtual calls and permanent virtual circuits.

In the absence of the throughput class selection and indication facility or other related user facilities (these facilities being for further study), the throughput classes considered for the call originated by the DTE are those agreed between the DTE and the Administration as the default values.

When the calling DTE has subscribed to the facility, it separately indicates throughput classes applied to each of the two directions of transmission of the virtual call.

When the called DTE has subscribed to the facility, the throughput classes of both directions of transmission are indicated to the called DTE in the INCOMING CALL packet. These throughput classes are those defined by the calling DTE either by default or explicitly.

Throughput classes give an indication to the network about the level of resources that need to be allocated to the virtual call or permanent virtual circuit. They do not necessarily have an effect upon packet length and window size locally used at the DTE/DCE interface (Note 1).

When the throughput class selection and indication facility is used, the window size and packet length to be used for each direction of transmission are selected by reference to tables specified by the Administration. These tables are built in such a manner that they take into account the relationship of throughput class to packet size and window size in those cases when such a relationship exists.

These tables are subject to an agreement between the Administration and the DTE, and must be such that, in the conditions of use expected by the user, the chosen window sizes and packet lengths effectively permit to reach, on the DTE/DCE interface, each one of the throughput classes.

<u>NOTE 1</u>: Users are cautioned that the choice of too small a window and packet size at a DTE/DCE interface may adversely affect the attainable throughput class of a virtual call or permanent virtual circuit. This is likewise true of flow control mechanisms adopted by the DTE to control data transmission from the DCE.

<u>NOTE 2</u>: On a permanent virtual circuit, no mechanism is provided to dynamically select throughput class ncr for the network to indicate throughput classes.

5.1.3 Reverse Charging Acceptance

Reverse Charging Acceptance is an optional user facility agreed for a period of time.

This user facility, if subscribed to, authorizes the DCE to transmit to the DTE incoming calls which request the Reverse Charging facility. In the absence of this facility, the DCE will not transmit to the DTE incoming calls which request the Reverse Charging facility.

5.1.4 One-Way Logical Channel

One-way Logical Channel is an optional user facility agreed for a period of time.

This is a user facility which limits the use of a logical channel to either incoming or outgoing calls (incoming or outgoing access on logical channels).

5.1.5 Packet Retransmission

Packet Retransmission is an optional user facility agreed for a period of time.

This user facility allows a DTE to request retransmission of one or several consecutive data packets from the DCE by transferring across the DTE/DCE interface a DTE REJECT packet specifying a logical channel number and a sequence number P(R). The value of this P(R) should be within the range from the last P(R) received by the DCE up to, but not including, the P(S) of the next data packet to be transmitted by the DCE.

When receiving a DTE REJECT packet, the DCE initiates on the specified logical channel retransmission of the data packets; the Packet Send Sequence Numbers of which are starting from P(R) where P(R) is indicated in the DTE REJECT packet. Until the DCE transfers across the DTE/DCE interface a DCE DATA packet with a Packet Send Sequence Number equal to the P(R) indicated in the DTE REJECT packet, the DCE will consider the receipt of another DTE REJECT packet as a procedure error and reset the virtual call or permanent virtual circuit.

Additional data packets pending initial transmission may follow the retransmitted data packet(s).

A DTE receive not ready situation indicated by the transmission of RNR packet is cleared by the transmission of a DTE REJECT packet.

The conditions under which the DCE ignores a DTE REJECT packet, or considers it as a procedure error, are those described for flow control packets.

5.1.6 Closed User Group Facility

Closed User Group is an optional user facility agreed for a period of time between the Administration and a group of users.

This facility permits the users of the group to communicate with each other, but precludes communication with all other users.

A DTE may belong to more than the closed user group.

The calling DTE should specify the closed user group selected for a virtual call using the optional user facility parameters in the CALL REQUEST packet.

The closed user group selected for a virtual call will be indicated to a called DTE using the optional user facility parameters in the INCOMING CALL packet.

When a DTE only belongs to one closed user group, this indication may not be present in the CALL REQUEST or INCOMING CALL packet.

5.1.7 Bilaterial Closed User Group Facility

A Bilateral Closed User Group facility is an optional user facility which can be used for a period of time by a DTE for virtual call. This facility permits such users to communicate with each other, but precludes communication with all other users.

A DTE may belong to more than one bilateral closed user group.

The calling DTE should specify the bilateral user group selected for a virtual call using the optional user facility parameter in the CALL REQUEST packet. The called DTE address length shall be coded all zeros.

The bilateral closed user group for a virtual call will be indicated to a called DTE using the optional user facility parameters in the INCOMING CALL packet.

5.2 Formats for Optional User Facilities

5.2.1 General

The facility field is present only when a DTE is using an optional user facility requiring some indication in the CALL REQUEST packet or the INCOMING CALL packet.

The facility field contains one or more facility elements. The first octet of each facility element contains a facility code to indicate the facility or facilities requested.

NOTE: The action taken by the DCE when a facility code appears more than once is for further study.

The facility codes are divided into four classes, by making use of bits 7 and 8 of the facility code field, in order to specify facility parameters consisting of 1, 2, 3, or a variable number of octets. The general class coding is shown below.

Facility code field

bit	8 7 6 5 4 3 2 1	
CLASS A	0 0 X X X X X X	for single octet parameter field
CLASS B	0 1 X X X X X X	for double octet parameter field
CLASS C	1 0 X X X X X X	for triple octet parameter field
CLASS D	1 1 X X X X X X	for variable length parameter field

For class D the octet following the facility code indicates the length, in octets, of the facility parameter field. The facility parameter field length is binary coded and bit 1 is the low order bit of this indicator.

CLASS A

	8	7	6	5	4	3	2	1
0	0	0	X	X	X	X	X	X
1	Facility parameter field							

CLASS B

	8	7	6	5	4	3	2	1
0	0	1	X	X	X	X	X	X
1	Facility parameter							
2	field							

CLASS C

	8	7	6	5	4	3	2	1
0	1	0	X	X	X	X	X	X
1	Facility							
2	parameter							
3	field							

CLASS D

	8	7	6	5	4	3	2	1
0	1	1	X	X	X	X	X	X
1	Facility parameter field length							
2	Facility parameter field							

Figure 5.1. Facility code general formats

The facility code field is binary coded and, without extension, provides for a maximum of 64 facility codes for classes A, B and C and 63 facility codes for class D giving a total of 255 facility codes.

Facility code 11111111 is reserved for extension of the facility code. The octet following this octet indicates an extended

facility code having the format A, B, C or D as defined above. Repetition of facility code 11111111 is permitted and thus additional extensions result.

The coding of the facility parameter field is dependent on the facility being requested.

A facility code may be assigned to identify a number of specific facilities, each having a bit in the parameter field indicating facility requested/facility not requested. In this situation, the parameter field is binary encoded with each bit position relating to a specific facility. A 0 indicates that the facility related to the particular bit is not requested and a 1 indicates that the facility related to the particular bit is requested. Parameter bit positions not assigned to a specific facility are set to zero. If none of the facilities represented by the facility code are requested for a virtual call, the facility code and its associated parameter field need not be present.

A Facility Marker, consisting of a single octet pair, is used to separate requests for X.25 facilities, as defined in this section, from requests for non-X.25 facilities that may also be offered by an Administration. The first octet is a facility code and is set to zero and the second octet is the facility parameter field.

The coding of the parameter field will be either all zeros or all ones depending on whether the facility requests following the marker refer to facilities offered by the calling or called network, respectively. For intra-network virtual calls, the parameter field should be all zeros.

Requests for facilities offered by the calling and called networks may be simultaneously present within the facility field and in such cases two Facility Markers will be required with parameter fields coded as described above.

Within the facility field, requests for X.25 facilities will precede all requests for non-X.25 facilities and Facility Markers need only be included when requests for non-X.25 facilities are present.

5.2.2 Coding of Facility Field for Particular Facilities

5.2.2.1 Coding of Reverse Charging Facility

The coding of the facility code and parameter fields for Reverse Charging is the same in CALL REQUEST and INCOMING CALL packets.

Facility Code Field

The coding of the facility code field for Reverse Charging is:

bit: 8 7 6 5 4 3 2 1

code: 0 0 0 0 0 0 0 1

Facility Parameter Field

The coding of the facility parameter field is as follows:

bit 1 = 0 for Reverse Charging not requested

bit 1 = 1 for Reverse Charging requested

NOTE: Bits 8, 7, 6, 5, 4, 3 and 2 could be used for user facilities other than for Reverse Charging; if not, they are set to 0.

5.2.2.2 Coding of Throughput Class Selection and Indication Facility

The inclusion of facility code and parameter fields for Throughput Class Selection and Indication is optional to the DTE.

The coding in INCOMING CALL packets and in CALL REQUEST packets is the same.

Facility Code Field

The facility code field for Throughput Class Selection and Indication is coded:

bit: 8 7 6 5 4 3 2 1

code: 0 0 0 0 0 0 1 0

Facility Parameter Field

The throughput class for transmission from the calling DTE is indicated in bits 4, 3, 2 and 1. The throughput class for transmission from the called DTE is indicated in bits 8, 7, 6 and 5.

The four bits indicating each throughput class are binary coded and express the logarithm base 2 of the number of octets per second defining the throughput class. Bit 1 or 5 is the low order bit of each throughput class indicator.

5.2.2.3 Coding of Closed User Group Facility

The coding of facility code field and parameters for Closed User Group is the same in CALL REQUEST and INCOMING CALL packets.

Facility Code Field

The coding of the facility code field for Closed User Groups is:

bit 8 7 6 5 4 3 2 1

code 0 0 0 0 0 0 1 1

Facility Parameter Field

The index to the Closed User Group selected for the virtual call is in the form of two decimal digits. Each digit is coded in a semi-octet in binary coded decimal with bit 5 being the low order bit of the first digit and bit 1 being the low order bit of the second digit.

Indexes to the same Closed User Group at different DTE/DCE interfaces may be different.

5.2.2.4 Coding of Bilateral Closed User Group Facility

The coding of facility code field and the format of the facility parameter field for Bilateral Closed User Group are the same in CALL REQUEST and INCOMING CALL packets.

Facility Code Field

The coding of facility code field for Bilateral Closed User Group is:

bit: 8 7 6 5 4 3 2 1

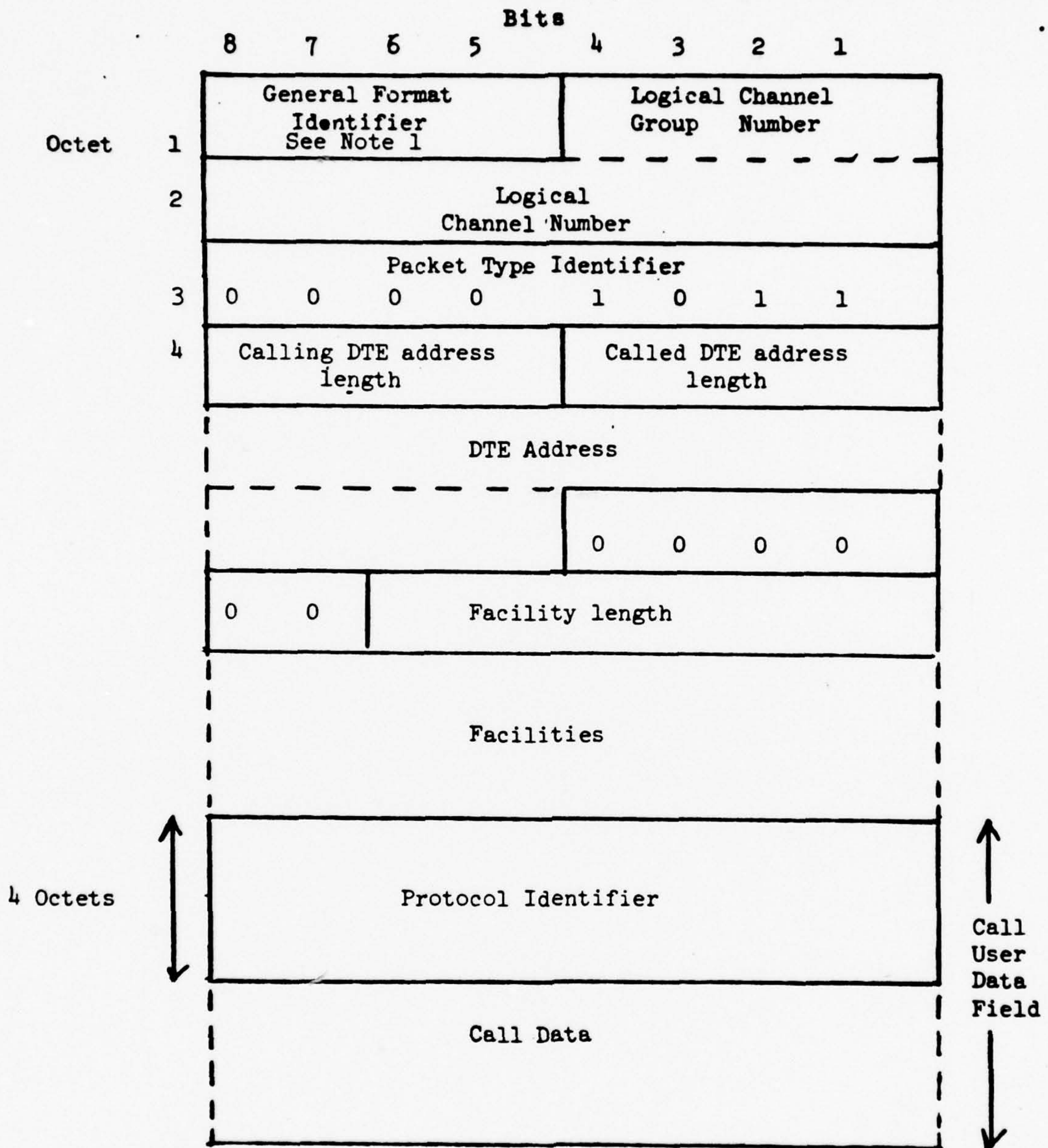
code: 0 1 0 0 0 0 0 1

Facility Parameter Field

The index to the Bilateral Closed User Group selected for the virtual call is in the form of 4 decimal digits.

Each digit is coded in a semi-octet in binary coded decimal with bit 5 of the first octet being low order bit of the first digit, bit 1 of the first octet being low order bit of the second digit, bit 5 of the second octet being low order bit of the third digit, and bit 1 of the second octet being low order bit of the fourth digit.

Indexes to the same Bilateral Closed User Group at different DTE/DCE interfaces may be different.



Note 1: Coded 0001 (modulo 8) or 0010 (modulo 128).

Note: The figure assumes that a single address is present consisting of an odd number of digits (however, both address fields may be present) and that the call user data field is an integral number of octets greater than 4, in length.

Figure 1/X.25 - Call request and incoming call packet format

Bits

Octet	8	7	6	5	4	3	2	1
1	General Format Identifier See Note				Logical Channel Group Number			
2	Logical Channel Number							
3	Packet Type Identifier 0	0	0	0	1	1	1	1
4	Calling DTE address length				Called DTE address length			
	DTE Address							
					0	0	0	0
	0	0	Facility length					
	Facilities							

Note: Coded 0001 (modulo 8) or 0010 (modulo 128).

Figure 2/X.25 - Call accepted and call connected packet format

	Bits							
	8	7	6	5	4	3	2	1
Octet 1	General Format Identifier See Note				Logical Channel Group Number			
2	Logical Channel Number							
3	Packet Type Identifier							
	0	0	0	1	0	0	1	1
4	Clearing Cause							
5	Diagnostic Code*							

Note: Coded 0001 (modulo 8) or 0010 (modulo 128)

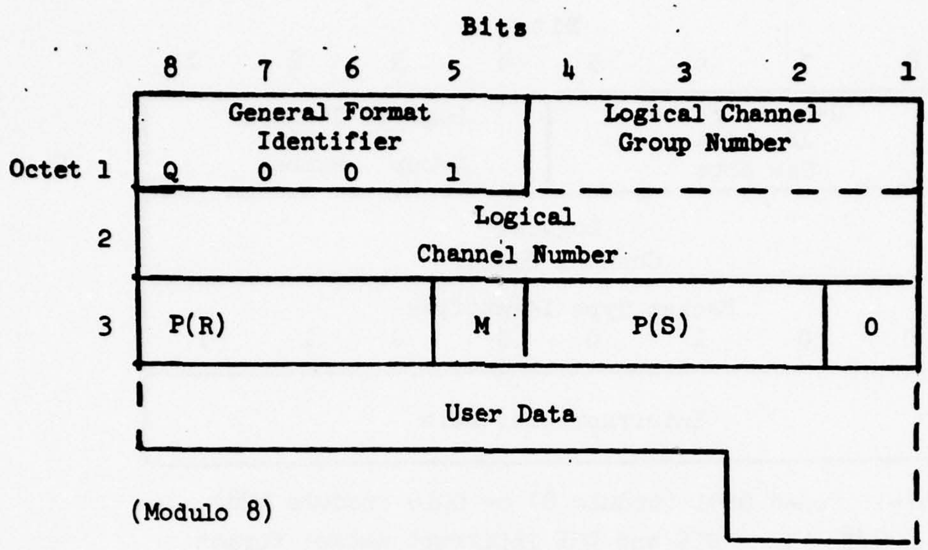
* This field is not mandatory in CLEAR REQUEST packets.

Figure 3/X.25 - Clear request and clear indication packet format

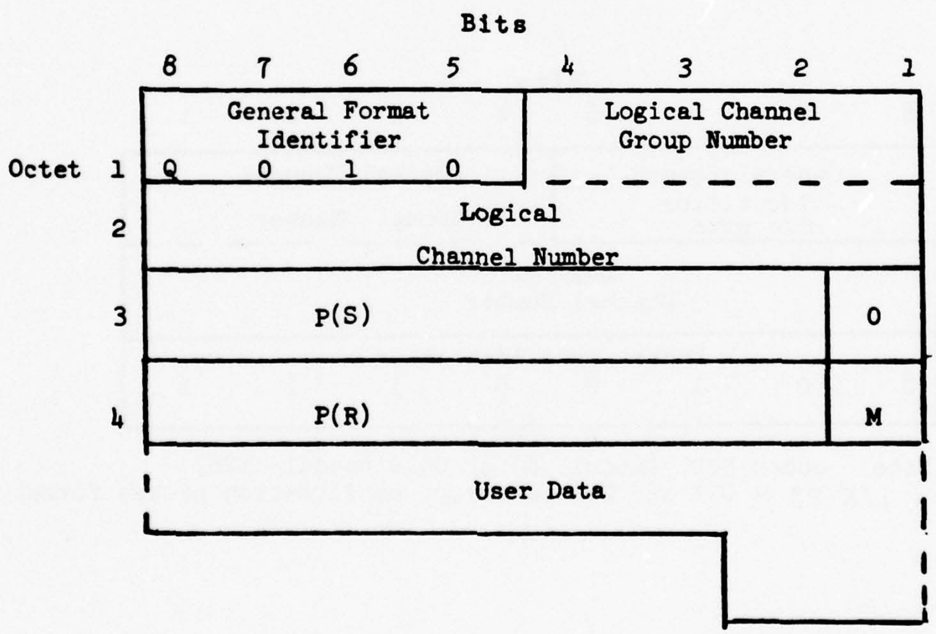
	Bits							
	8	7	6	5	4	3	2	1
Octet 1	General Format Identifier See Note				Logical Channel Group Number			
2	Logical Channel Number							
3	Packet Type Identifier							
	0	0	0	1	0	1	1	1

Note: Coded 0001 (modulo 8) or 0010 (modulo 128)

Figure 4/X.25 - DTE and DCE clear confirmation packet format



(Modulo 8)



(When extended to modulo 128)

M = More Data Indication

Q = Qualifier bit

Note: The figure assumes that the user data field does not contain an integral number of octets.

Figure 5/X.25 - DTE and DCE data packet format

Bits

Octet	8	7	6	5	4	3	2	1
1	General Format Identifier See Note				Logical Channel Group Number			
2	Logical Channel Number							
3	Packet Type Identifier							
	0	0	1	0	0	0	1	1
4	Interrupt User Data							

Note: Coded 0001 (modulo 8) or 0010 (modulo 128)

Figure 6/X.25 - DTE and DCE interrupt packet format

Bits

Octet	8	7	6	5	4	3	2	1
1	General Format Identifier See note				Logical Channel Group Number			
2	Logical Channel Number							
3	Packet Type Identifier							
	0	0	1	0	0	1	1	1

Note: coded 0001 (modulo 8) or 0010 (modulo 128)

Figure 7/X.25 - DTE and DCE interrupt confirmation packet format

Bits

	8	7	6	5	4	3	2	1
Octet 1	General Format Identifier				Logical Channel Group Number			
	0	0	0	1				
2	Logical Channel Number							
3	P(R)			0	0	0	0	1

(Modulo 8)

Bits

	8	7	6	5	4	3	2	1
Octet 1	General Format Identifier				Logical Channel Group Number			
	0	0	1	0				
2	Logical Channel Number							
3	0	0	0	Packet Type Identifier				
				0	0	0	0	1
4	P(R)							0

(when extended to Modulo 128)

Figure 8/X.25 - DTE and DCE RR packet format

Bits

Octet	8	7	6	5	4	3	2	1
	General Format Identifier				Logical Channel Group Number			
1	0	0	0	1				
2	Logical Channel Number							
3	P(R)			0	0	1	0	1

(Modulo 8)

Bits

Octet	8	7	6	5	4	3	2	1
	General Format Identifier				Logical Channel Group Number			
1	0	0	1	0				
2	Logical Channel Number							
				Packet Type Identifier				
3	0	0	0	0	0	1	0	1
4	P(R)							0

(when extended to Modulo 128)

Figure 9/X.25 - DTE and DCE RNR packet format

Bits

Octet	8	7	6	5	4	3	2	1
1	General Format Identifier See Note				Logical Channel Group Number			
2	Logical Channel Number							
3	Packet Type Identifier							
	0	0	0	1	1	0	1	1
4	Resetting Cause							
5	Diagnostic Code*							

Note: Coded 0001 (modulo 8) or 0010 (modulo 128)

* This field is not mandatory in RESET REQUEST packets.

Figure 10/X.25 - Reset request and reset indication packet format

Bits

Octet	8	7	6	5	4	3	2	1
1	General Format Identifier See Note				Logical Channel Group Number			
2	Logical Channel Number							
3	Packet Type Identifier							
	0	0	0	1	1	1	1	1

Note: Coded 0001 (modulo 8) or 0010 (modulo 128)

Figure 11/X.25 - DTE and DCE reset confirmation packet format

	Bits							
	8	7	6	5	4	3	2	1
Octet 1	General Format Identifier See Note				0	0	0	0
2	0	0	0	0	0	0	0	0
3	Packet Type Identifier							
	1	1	1	1	1	0	1	1
4	Restarting Cause							
5	Diagnostic Code*							

Note: Coded 0001 (modulo 8) or 0010 (modulo 128)

* This field is not mandatory in RESTART REQUEST packets

Figure 12/X.25 - Restart request and restart indication packet format

	Bits							
	8	7	6	5	4	3	2	1
Octet 1	General Format Identifier See Note				0	0	0	0
2	0	0	0	0	0	0	0	0
	Packet Type Identifier							
3	1	1	1	1	1	1	1	1

Note: Coded 0001 (modulo 8) or 0010 (modulo 128)

Figure 13/X.25 - DTE and DCE restart confirmation packet format

Bits

	8	7	6	5	4	3	2	1
Octet 1	General Format Identifier 0	0	0	1	Logical Channel Group Number			
2	Logical Channel Number							
3	P(R)			0	1	0	0	1

(Modulo 8)

Bits

	8	7	6	5	4	3	2	1
Octet 1	General Format Identifier 0	0	1	0	Logical Channel Group Number			
2	Logical Channel Number							
3	0	0	0	Packet Type Identifier 0	1	0	0	1
4	P(R)							0

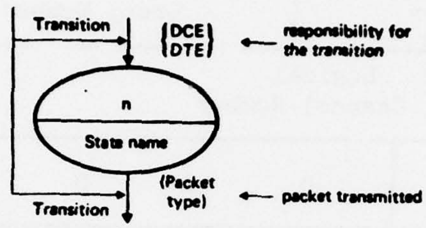
(When extended to modulo 128)

Figure 14/X.25 - DTE REJ packet format

ANNEX 1
(to Recommendation X.25)

PACKET LEVEL DTE/DCE INTERFACE STATE DIAGRAMS

Symbol definition of the state diagrams



NOTE 1: Each state is represented by an ellipse wherein the state name and number are indicated.

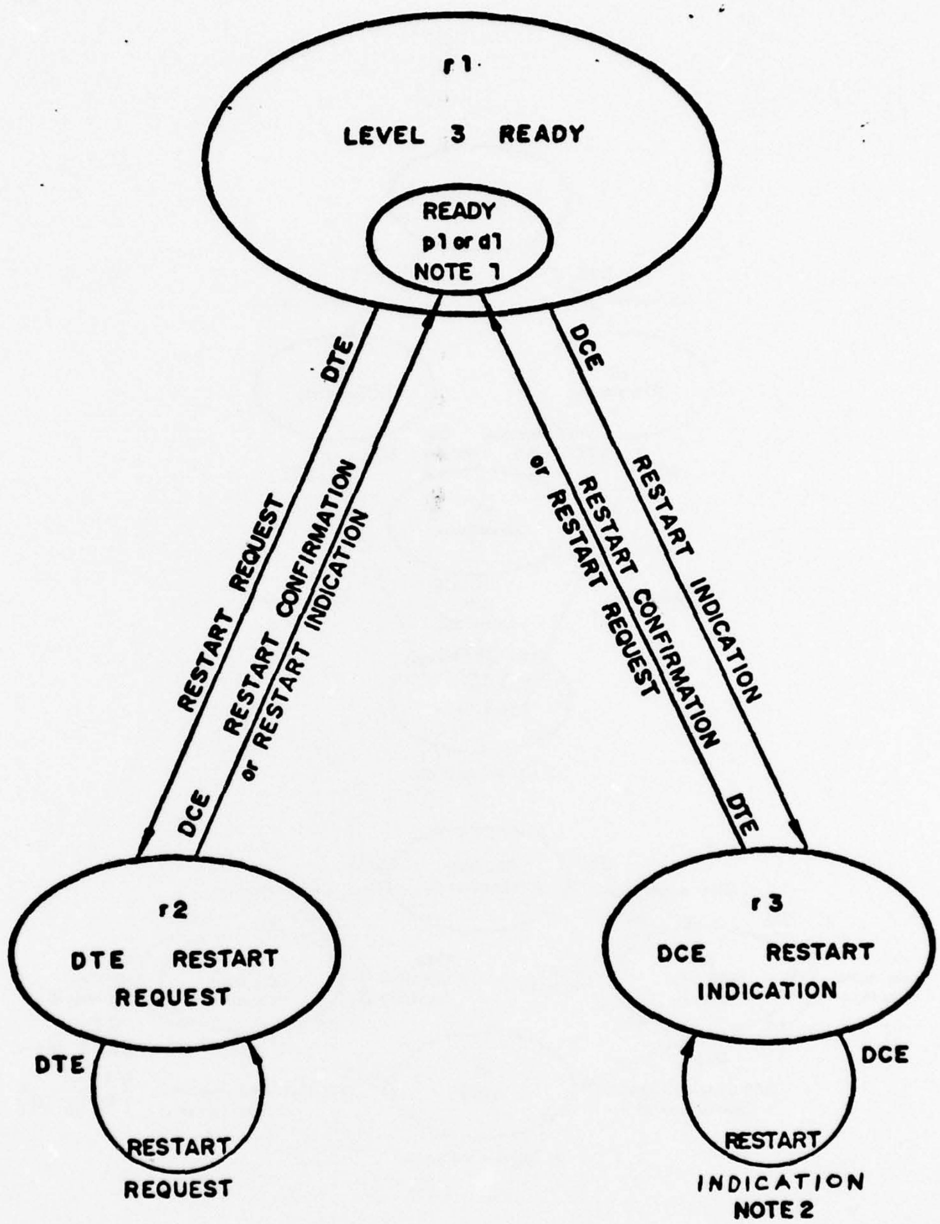
NOTE 2: Each state transition is represented by an arrow. The responsibility for the transition (*DTE or DCE*) and the packet it has successfully transmitted are indicated beside that arrow.

Order definition of the state diagrams

For the sake of clarity, the normal procedure at the interface is described in a number of small state diagrams. In order to describe the normal procedure fully it is necessary to allocate a priority to the different figures and to relate a higher order diagram with a lower one. This has been done by the following means:

- The figures are arranged in order of priority with Figure 15/X.25 (Restart) having the highest priority and subsequent figures having lower priority. Priority means that when a packet belonging to a higher order diagram is transmitted, that diagram is applicable and the lower order one is not.

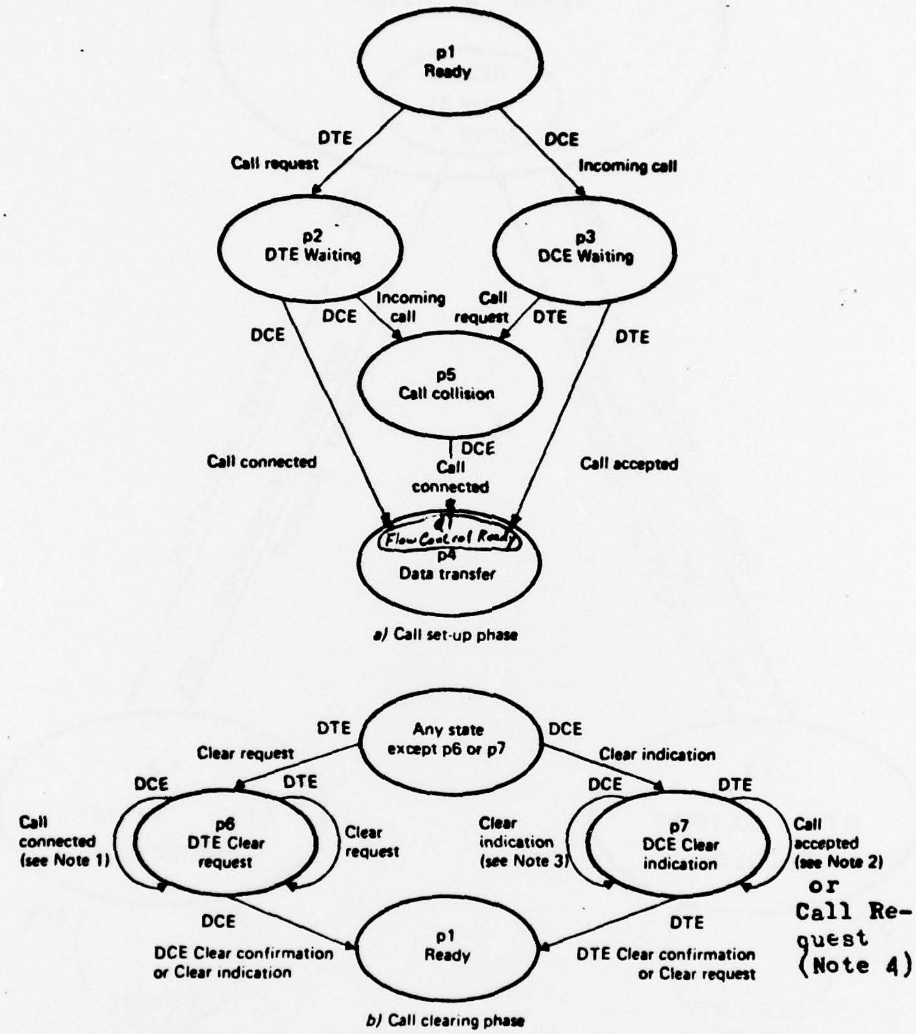
- The relation with a state in a lower order diagram is given by including that state inside an ellipse in the higher order diagram.



Note 1: State p1 for virtual calls or state d1 for permanent virtual circuits.

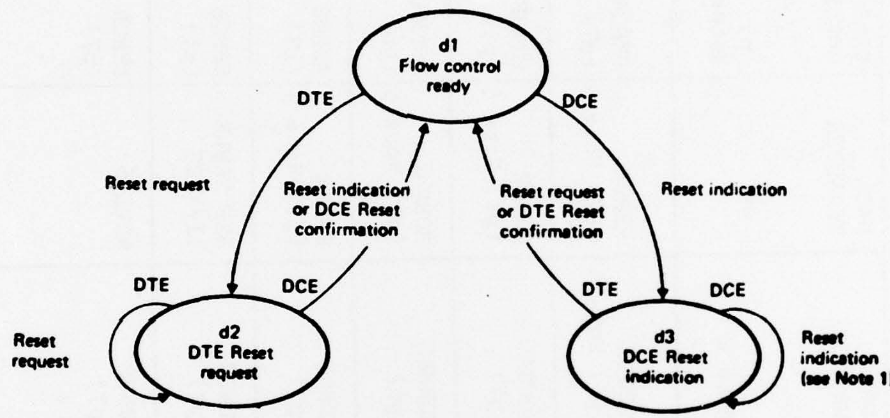
Note 2: This transition may take place after a timeout in the network.

Figure 15/X.25 - Diagram of states for the transfer of restart packets.



Note 1. – This transition is possible only if the previous state was *DTE Waiting* (p2).
Note 2. – This transition is possible only if the previous state was *DCE Waiting* (p3).
Note 3. – This transition may take place after a time-out in the network.
Note 4 - This transition is possible only if the previous state was Ready (p1) or DCE Waiting (p8).

Figure 16/X.25 - Diagram of states for the transfer of call set-up and call clearing packets within the level 3 ready (r1) state.



Note : These transitions occur only in the DATA TRANSFER state (p4).

Note 1. – This transition may take place after a time-out in the network.

Figure 17/X.25 - Diagram of states for the transfer of reset packets within the data transfer (p4) state

ANNEX 2

(to Recommendation X.25)

TABLE 10/X.25

<u>Action taken by the DCE on receipt of packets in a given state of the packet level DTE/DCE interface as perceived by the DCE: call setup, clearing and data transfer on assigned logical channels (Note 1)</u>

The figures in brackets are the new states to be entered.

State of the interface as perceived by the DCE / Packet from the DTE with assigned logical channel	READY p1	DTE WAITING p2 Note 3	DCE WAITING p3 Note 2	DATA TRANSFER p4	CALL COLLISION p5 Notes 2,3	DTE CLEAR REQUEST p6	DCE CLEAR INDICATION p7
CALL REQUEST	NORMAL (p2) Note 4	ERROR (p7)	NORMAL (p5) Note 4	ERROR (p7) Note 5	ERROR (p7)	ERROR (p7)	DISCARD (p7)
CALL ACCEPTED	ERROR (p7)	ERROR (p7)	NORMAL (p4)	ERROR (p7) Note 5	ERROR (p7)	ERROR (p7)	DISCARD (p7)
CLEAR REQUEST	NORMAL (p6)	NORMAL (p6)	NORMAL (p6)	NORMAL (p6) Note 5	NORMAL (p6)	DISCARD (p6)	NORMAL (p1)
DTE CLEAR CONFIRMATION	ERROR (p7)	ERROR (p7)	ERROR (p7)	ERROR (p7) Note 5	ERROR (p7)	ERROR (p7)	ERROR (p1)
DATA, INTERRUPT, RESET OR FLOW CONTROL	ERROR (p7)	ERROR (p7)	ERROR (p7)	SEE TABLE 11/X.25	ERROR (p7)	ERROR (p7)	DISCARD (p7)
RESTART REQUEST OR DTE RESTART CONFIRMATION WITH BITS 1 TO 4 OF OCTET 1 OR 1 TO 8 OF OCTET 2 $\neq$ 0	ERROR (p7)	ERROR (p7)	ERROR (p7)	NOTE 6	ERROR (p7)	ERROR (p7)	DISCARD (p7)
PACKETS HAVING A PACKET TYPE IDENTIFIER WHICH IS SHORTER THAN ONE OCTET OR IS INCOMPATIBLE WITH THE ONES DEFINED IN SECTION 4/X.25	ERROR (p7)	ERROR (p7)	ERROR (p7)	NOTE 6	ERROR (p7)	ERROR (p7)	DISCARD (p7)

NOTES TO TABLE 10/X.25

NORMAL: The action taken by the DCE follows the procedures as defined in section 3.

ERROR: The DCE discards the received packet and indicates a clearing by transmitting to the DTE a CLEAR INDICATION packet, with an indication of Local Procedure Error. If connected through the virtual call, the distant DTE is also informed of the clearing by a CLEAR INDICATION packet, with an indication of Remote Procedure Error.

The coding of diagnostic codes to be used in the ERROR procedure are listed in Table 7bis/X.25.

It is required that in the absence of an appropriate DTE response to a CLEAR INDICATION packet issued as a result of an error condition in state p6, the DCE should eventually consider the DTE/DCE interface to be in the READY state (p1).

DISCARD: The DCE discards the received packet and takes no subsequent action as a direct result of receiving that packet.

NOTE 1: The actions taken by the DCE on receipt of packets with unassigned logical channels are given in Table 13/X.25.

NOTE 2: This state does not exist in the case of an outgoing one-way logical channel (as perceived by the DTE).

NOTE 3: This state does not exist in the case of an incoming one-way logical channel (as perceived by the DTE).

NOTE 4: In the case of an incoming one-way logical channel (as perceived by the DTE) the DCE will use the ERROR procedure.

NOTE 5: In the case of an permanent virtual circuit the DCE discards the received packet and indicates a reset by transmitting to the DTE a RESET INDICATION packet, with an indication of Local Procedure Error. The distant DTE is also informed of the reset by a RESET INDICATION packet, with an indication of Remote Procedure Error.

NOTE 6: This entry is for further study. The following alternatives have been proposed:

1) "ERROR (p7) note 5"; or

2) "See Table 11/X.25" - Note - In this case, the following two lines should be added to Table 11/X.25.

NOTES TO TABLE 10/X.25 - Continued

Restart request or DTE Restart confirmation with bits 1 to 4 of octet 1 or 1 to 8 of octet 2 ≠ 0	flow control error (d3)	flow control error (d3)	discard (d3)
Packets having a packet type identifier which is shorter than one octet or is incompatible with the ones defined in section 4/X.25	flow control error (d3)	flow control error (d3)	discard (d3)

TABLE 11/X.25

<u>Action taken by the DCE on receipt of packets in a given state of the packet level DTE/DCE interface as perceived by the DCE: data transfer (flow control and reset) on assigned logical channels (Note 1)</u>

The figures in brackets are the new states to be entered.

State of the Interface as perceived by the DCE / Packet from the DTE with assigned logical channel	DATA TRANSFER p4		
	FLOW CONTROL READY d1	DTE RESET REQUEST d2	DCE RESET INDICATION d3
RESET REQUEST	NORMAL (d2)	DISCARD (d2)	NORMAL (d1)
DTE RESET CONFIRMATION	FLOW CONTROL ERROR (d3)	FLOW CONTROL ERROR (d3)	NORMAL (d1)
DATA, INTERRUPT OR FLOW CONTROL	NORMAL (d1) Note 2	FLOW CONTROL ERROR (d3)	DISCARD (d3)
DATA PACKETS WITH THE DATA FIELD LENGTH EXCEEDING THE MAXIMUM PERMITTED VALUE	FLOW CONTROL ERROR (d3)	FLOW CONTROL ERROR (d3)	DISCARD (d3)

NOTES TO TABLE 11/X.25

NORMAL: The action taken by the DCE follows the procedures as defined in section 3.

FLOW CONTROL ERROR: The DCE discards the received packet and indicates a reset by transmitting to the DTE a RESET INDICATION packet, with an indication of Local Procedure Error. The distant DTE is also informed of the reset by a RESET INDICATION packet, with an indication of Remote Procedure Error.

If a RESET INDICATION is issued as a result of a flow control error condition in state d2 for permanent virtual circuits, the DCE should eventually consider the DTE/DCE interface to be in the FLOW CONTROL READY state (d1). In this case the action to be taken on a virtual call is for further study.

DISCARD: The DCE discards the received packet and takes no subsequent action as a direct result of receiving that packet.

NOTE 1: The actions taken by the DCE on receipt of packets with unassigned logical channels are given in Table 13/X.25.

NOTE 2: The DCE will consider the receipt of a DTE INTERRUPT CONFIRMATION packet which does not correspond to a yet unconfirmed DCE INTERRUPT packet as a flow control error and will reset the virtual call or permanent virtual circuit. The DCE will either discard or consider as a flow control error a DTE INTERRUPT packet received before a previous DTE INTERRUPT packet has been confirmed.

TABLE 12/X.25

Action taken by the DCE on receipt of packets in a given state of the packet level DTE/DCE interface as perceived by the DCE: restart procedure for assigned logical channels (Note 1)

The figures in brackets are the new states to be entered.

Packet from the DTE with assigned logical channel \ State of the Interface as perceived by the DCE	LEVEL 3 READY r1	DTE RESTART REQUEST r2	DCE RESTART INDICATION r3
RESTART REQUEST	NORMAL (r2)	DISCARD (r2)	NORMAL (p1 or d1) Note 2
DTE RESTART CONFIRMATION	ERROR (r3)	ERROR (r3)	NORMAL (p1 or d1) Note 2
DATA, INTERRUPT, CALL SET-UP AND CLEARING, FLOW CONTROL OR RESET (Note 3)	SEE TABLE 10/X.25 OR TABLE 11/X.25	ERROR (r3)	DISCARD (r3)
RESTART REQUEST OR DTE RESTART CONFIRMATION WITH BITS 1 TO 4 OF OCTET 1 OR BITS 1 TO 8 OF OCTET 2 $\neq$ 0	SEE TABLE 10/X.25	ERROR (r3)	DISCARD (r3)
PACKETS HAVING A PACKET TYPE IDENTIFIER WHICH IS SHORTER THAN 1 OCTET OR IS INCOMPATIBLE WITH THE ONES DEFINED IN SECTION 4	SEE TABLE 10/X.25	ERROR (r3)	DISCARD (r3)

NOTES TO TABLE 12/X.25

NORMAL: The action taken by the DCE follows the procedures as defined in Section 3.

ERROR: The DCE discards the received packet and indicates a restarting by transmitting to the DTE a RESTART INDICATION packet, with an indication of Local Procedure Error. If connected through the virtual call, the distant DTE is also informed of the restarting by a CLEAR INDICATION packet, with an indication of Remote Procedure Error. In the case of a permanent virtual circuit, the distant DTE will be informed by a RESET INDICATION packet, with an indication of Remote Procedure Error.

If a RESTART INDICATION is issued as a result of an error condition in state r2, the DCE should eventually consider the DTE/DCE interface to be in the LEVEL 3 READY state (r1).

DISCARD: The DCE discards the received packet and takes no subsequent action as a direct result of receiving that packet.

NOTE 1: The actions taken by the DCE on receipt of packets with unassigned logical channels are given in Table 13/X.25.

NOTE 2: p1 for logical channels assigned to virtual calls; d1 for logical channels assigned to permanent virtual circuits.

NOTE 3: The DCE reaction to such packets received during states R1 and R2 is independent of any irregularities (eg format errors) that may exist in the packet structure.

TABLE 13/X.25

Special Cases

Packet from the DTE	Any state
ANY PACKET WITH UNASSIGNED LOGICAL CHANNEL	DISCARD
ANY PACKET WITH PACKET LENGTH < 2 OCTETS	DISCARD
ANY PACKET WITH INCORRECT GENERAL FORMAT IDENTIFIER	DISCARD

DISCARD: The DCE discards the received packet and takes no subsequent action as a direct result of receiving that packet.